Listing of Claims

1. (Previously Presented) A method comprising:

obtaining a Finite Element Model (FEM) of a component;

analyzing said FEM to obtain stresses at nodes of said FEM;

determining a Representative Volume Element (RVE) for at least one of said nodes;

building a microstructure-based failure model for at least one said RVE and including the microstructure-based failure model in the RVE;

simulating a component life using at least one RVE microstructure-based failure model, said simulating producing a result related to said component life;

performing said simulating a plurality of times to produce results related to component life; and

using the results to provide a prediction of failure for the component.

2. (Previously Presented) The method of claim 1, wherein said microstructure-based failure model comprises fatigue failure modeling information.

3. (Previously Presented) The method of claim 1, wherein each said microstructure-based failure model comprises at least one random variable and wherein probabilistic methods are used to provide values for said at least one random variable.

4. (Previously Presented) The method of claim 1, wherein said simulating further comprises:

establishing an RVE life for each said RVE, and

using each said RVE life to produce the result related to said component life.

5. (Previously Presented) The method of claim 1, said building comprising:

receiving information indicative of a selected material microstructure in said RVE; and

receiving pre-determined failure modeling information for said selected material microstructure, wherein the pre-determined failure modeling information includes modeling information for one or more damage mechanisms for the selected material microstructure.

6. (Previously Presented) The method of claim 5, wherein said pre-determined failure modeling information for the selected material microstructure includes modeling information for at least one mechanical characteristic of the selected material microstructure, and further includes modeling information for at least one bulk elastic material characteristic of the selected material microstructure.

7. (Previously Presented) The method of claim 5, wherein said pre-determined failure modeling information comprises crack nucleation modeling information, short crack growth modeling information, and long crack growth modeling information.

8. (Previously Presented) The method of claim 1, said simulating further comprising:

determining an RVE life for each said RVE, said determining an RVE life comprising:

evaluating a statistically determined number of nucleation sites within said RVE utilizing probabilistic methods.

9. (Original) The method of claim 8, wherein said probabilistic methods comprise Monte Carlo (MC) methods.

10. (Previously Presented) The method of claim 1, further comprising:

identifying a subset of said nodes as significant nodes based on said stresses.

11. (Currently Amended) The method of claim 10, wherein identifying a subset of said nodes comprises obtaining a statistical distribution of said stresses at said nodes, ~~an~~ and wherein said simulating a component further comprises establishing an RVE life for each RVE using probabilistic methods comprising Monte Carlo methods.

12. (Original) The method of claim 1, wherein said component has regions of similar geometric detail and said simulating further comprises adding a spatial correlation for said regions.

13. (Original) The method of claim 10, wherein said component has regions of similar geometric detail and said simulating further comprising adding a spatial correlation for said regions.

14. (Previously Presented) The method of claim 5, wherein said microstructure-based failure model comprises random variables and wherein probabilistic methods are used to provide values for said random variables.

15. (Original) The method of claim 14, wherein said probabilistic methods rely upon simulation-based methods.

16. (Original) The method of claim 15, wherein said simulation-based methods are direct methods selected from a group consisting of: Monte Carlo (MC) methods, and importance sampling methods.

17. (Previously Presented) The method of claim 5, wherein said pre-determined failure modeling information includes crack nucleation modeling information, short crack growth modeling information, and long crack growth modeling information based on the one or more damage mechanisms for the selected material microstructure, and wherein said building comprises linking said crack nucleation modeling information, short crack growth modeling information, and long crack growth modeling information.

18. (Previously Presented) The method of claim 5, wherein said pre-determined failure modeling information includes crack nucleation modeling information based on at least one of the one or more damage mechanisms for the selected material microstructure, wherein the crack nucleation modeling information is indicative of a damage interaction with said selected material microstructure for said one or more damage mechanisms.

19 – 40. (Cancelled).

41. (Previously Presented) An article comprising a machine-readable medium storing instructions operable to cause one or more machines to perform operations comprising:

receive information indicative of a component configuration of a component;

obtain a finite element model (FEM) information associated with the component;

analyze the FEM to obtain stresses at one or more nodes of the FEM;

determine at least one Representative Volume Element (RVE) for one or more associated nodes; and

simulate a first component life using at least one microstructure-based failure model included in the at least one RVE based on a first selected microstructure of a plurality of available microstructures for the component to obtain a first output;

simulate a second component life for the at least one RVE based on a second different selected microstructure of the plurality of available microstructures for the component to obtain a second output; and

using the first output and second output to provide a prediction of failure for the component.

42. (Previously Presented) The article of claim 41, wherein the instructions further comprise:

generate information indicative of a first component lifetime based on the first output; and

generate information indicative of a second component lifetime based on the second output.

43. (Previously Presented) The article of claim 42, wherein the operations further comprise:

generate statistics using said information indicative of the first component lifetime and the second component lifetime.

44. (Previously Presented) The article of claim 43, wherein the operations further comprise:

compare the statistics to information indicative of one or more probability of failure criteria.

45. (Previously Presented) The article of claim 41, wherein the microstructure-based failure model for the RVE comprises fatigue failure modeling information.

46. (Previously Presented) The article of claim 41, wherein the operations further comprise:

simulate a component life a plurality of times for each RVE to obtain information indicative of a RVE life for each RVE; and

using the information indicative of the RVE life for each RVE to generate statistics for each RVE; and

compare the statistics to information indicative of one or more probability of failure criteria.

47. (Previously Presented) A system, comprising:

a processor;

an input device configured to receive input; and

one or more machine-readable media storing instructions operable to cause one or more machines to perform operations comprising:

receive information indicative of a component configuration of a component;

obtain a finite element model (FEM) information associated with the component;

analyze the FEM to obtain stresses at one or more nodes of the FEM;

determine at least one Representative Volume Element (RVE) for one or more associated nodes; and

simulate a first component life using at least one microstructure-based failure model included in the at least one RVE based on a first selected microstructure of a plurality of available microstructures for the component to obtain a first output; and

simulate a second component life for the at least one RVE based on a second different selected microstructure of the plurality of available microstructures for the component to obtain a second output; and

using the first output and second output to provide a prediction of failure for the component.

48. (Previously Presented) The system of claim 47, wherein the instructions further comprise:

generate information indicative of a first component lifetime based on the first output; and

generate information indicative of a second component lifetime based on the second output.

49. (Previously Presented) The system of claim 48, wherein the operations further comprise:

generate statistics using said information indicative of the first component lifetime and the second component lifetime.

50. (Previously Presented) The system of claim 49, wherein the operations further comprise:

compare the statistics to information indicative of one or more probability of failure criteria.

51. (Previously Presented) The system of claim 47, wherein the microstructure-based failure model for the RVE comprises fatigue failure modeling information.

52. (Previously Presented) The system of claim 47, wherein the operations further comprise:

simulate a component life a plurality of times for each RVE to obtain information indicative of a RVE life for each RVE; and

using the information indicative of the RVE life for each RVE to generate statistics for each RVE; and

compare the statistics to information indicative of one or more probability of failure criteria.

53. (Currently Amended) The method of claim 1, further comprising:

preparing statistics using said results; and

comparing said statistics to [[a]] one or more probability of failure (POF) criteria; and if the one or more criteria is not met, repeating the steps of simulating, performing and using with a different component.